Enhanced Water Quality Monitoring and Modeling Program for the A.R.M. Loxahatchee National Wildlife Refuge Quarterly Update Report – June 2013

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Overview

This update is a summary of activities since the previous status report of June 2013 on the implementation of the Refuge's Enhanced Water Quality Monitoring and Modeling Program. A project overview, and other detailed information about the program can be found at: http://sofia.usgs.gov/lox_monitor_model/. The primary objective of this overall program (Brandt et al. 2004) focuses on providing information for use in ecological management of the Refuge (e.g., USFWS 2007a, b; USFWS 2009; USFWS 2010a, b; USFWS 2012a; USFWS 2012b; USFWS 2013).

The Refuge's monitoring component of this program also addresses one of the Consent Decree Principals recommendations (17 December 2003):

> ***B. Enhancing Monitoring of the Refuge***
> *Design and implement an enhanced monitoring program to improve spatial and temporal understanding of factors related to phosphorus dynamics.*

Information Availability

Through collaboration with USGS, information from the Refuge's Enhanced Water Quality Monitoring and Modeling Program has been made available on the USGS' SOFIA web site at: http://sofia.usgs.gov/lox_monitor_model/.

Final data for monthly samples through May 2006 are publicly posted on DBHYDRO by the SFWMD at http://my.sfwmd.gov/dbhydroplsql/show_dbkey_info.main_page. Data for June 2006 – June 2013 are posted on the Technical Oversight Committee's web site at http://www.sfwmd.gov/toc/. This report includes information from samples collected through June 2013.

Water Quality Data Analyses Update

Primary efforts for this quarter involved exploring mechanisms to continue translating information from the program to aid in Refuge management decisions, and working on the program's Annual Report.

Monitoring Update (April – June 2013)

Sampling of the enhanced water quality monitoring network (**Figure 1**) occurred at 18 stations in April, 26 in May, and 32 in June 2013 (**Table 1**).

Total phosphorus data available to date for July 2012 through June 2013 are presented in **Table 1**. Maps of stations where samples were collected for the months from April through June 2013 are presented in **Figures 2-4**.

Conductivity sonde deployment information for July 2012 through June 2013 is presented in **Table 2**.

Next Steps

The next steps for this program include additional efforts on the Annual Report, and additional model development and application.

References

Brandt, L.A., Harwell, M., Waldon, M. (2004) Work Plan: Water Quality Monitoring and Modeling for the A.R.M. Loxahatchee National Wildlife Refuge: 2004-2006. Prepared for the A.R.M. Loxahatchee National Wildlife Refuge. April, 2004. 33 pp.

USFWS. (2007a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Monitoring and Modeling Program – 2nd Annual Report – February 2007. LOXA06-008, U.S. Fish and Wildlife Service, Boynton Beach, FL. 183 pp.

USFWS. (2007b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 3rd Annual Report – October 2007. LOXA07-005, U.S. Fish and Wildlife Service, Boynton Beach, FL. 116 pp.

USFWS. (2009) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 4th Annual Report – July 2009. LOXA09-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 106 pp.

USFWS. (2010a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 5th Annual Report – September 2010. LOXA08-007, U.S. Fish and Wildlife Service, Boynton Beach, FL. 43 pp.

USFWS. (2010b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 6th Annual Report – October 2010. LOXA09-011, U.S. Fish and Wildlife Service, Boynton Beach, FL. 42 pp.

USFWS. (2012a) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 7th Annual Report – February 2012. LOXA12-001, U.S. Fish and Wildlife Service, Boynton Beach, FL. 115 pp.

USFWS. (2012b) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 8th Annual Report – October 2012. LOXA12-004, U.S. Fish and Wildlife Service, Boynton Beach, FL. 68 pp.

USFWS. (2013) A.R.M. Loxahatchee National Wildlife Refuge - Enhanced Water Quality Monitoring and Modeling Program – 8th Annual Report – June 2013. LOXA13-001, U.S. Fish and Wildlife Service, Boynton Beach, FL. 71 pp.

Table 1. Total phosphorus data (ppb) available for July 2012 – June 2013 from the Enhanced Water Quality Monitoring Program for: (a) marsh, and (b) canal stations for the A.R.M. Loxahatchee National Wildlife Refuge. Graphical representation of station locations are shown in Figure 1.

a) Marsh stations

Marsh Station	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13
LOXA101	8	6	108	26	32	20	23	19	21	-	14	179
LOXA102	-	-	12	12	11	13	11	10	6	-	-	16
LOXA103	-	8	10	13	8	11	8	6	-	-	-	21
LOXA105	-	14	79	41	14	18	20	17	13	-	9	153
LOXA106	-	8	17	13	10	13	9	8	6	-	-	19
LOXA107	-	-	11	10	7	13	8	-	-	-	-	12
LOXA108	6	4	12	8	5	5	6	-	-	-	-	10
LOXA109	7	5	12	11	7	10	7	6	6	8	7	13
LOXA110	6	5	10	8	7	9	10	12	8	7	5	8
LOXA111	6	4	5	9	7	6	5	4	3	7	4	8
LOXA112	6	6	10	11	8	8	6	6	6	5	6	17
LOXA113	7	4	6	7	6	3	12	U	5	10	5	7
LOXA114	5	4	8	7	6	4	8	3	7	8	6	24
LOXA117	11	13	12	30	19	16	14	8	6	12	7	16
LOXA118	5	7	6	10	8	8	9	9	3	6	6	9
LOXA119	9	7	8	9	8	5	7	5	6	9	8	7
LOXA120	22	5	4	7	7	5	8	4	7	4	5	6
LOXA122	8	11	9	22	12	18	13	9	6	13	8	11
LOXA124	10	14	31	23	17	17	19	11	12	-	7	185
LOXA126	5	7	6	12	6	6	12	4	4	U	4	13
LOXA127	4	8	6	9	8	4	7	4	7	6	5	3
LOXA128	6	5	5	8	6	4	7	6	8	-	4	6
LOXA130	7	9	13	18	8	11	9	13	5	5	5	22
LOXA131	11	7	8	13	6	6	6	4	4	4	7	9
LOXA133	-	18	23	28	15	17	16	26	9	-	-	29
LOXA134	9	8	9	22	8	9	10	8	5	4	7	14
LOXA136	12	12	20	26	15	64	17	26	10	-	14	21
LOXA137	8	9	22	17	10	13	12	10	6	7	8	14
LOXA138	6	4	6	12	7	7	17	8	7	4	7	12
LOXA139	6	4	10	15	7	7	4	11	7	-	6	9
LOXA140	7	5	14	12	10	12	14	10	7	-	5	27
LOXA141	14	13	7	11	11	14	14	9	11	11	11	9
MAX	22	18	108	41	32	64	23	26	21	13	14	185
MIN	4	4	4	7	5	3	4	3	3	4	4	3

U indicates that compound was analyzed, but the concentration was below the minimum detection limit.

Table 1 cont.

b) Canal stations

Canal Station	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13
LOXA104	20	19	59	40	24	49	28	24	26	28	38	270
LOXA115	3	21	46	37	27	19	19	13	19	20	47	83
LOXA129	39	20	48	31	24	33	24	26	20	31	45	54
LOXA132	43	16	44	30	26	28	23	18	23	26	41	55
LOXA135	25	12	45	30	30	25	23	20	21	26	60	58
MAX	43	21	59	40	30	49	28	26	26	31	60	270
MIN	3	12	44	30	24	19	19	13	19	20	38	54

Table 2. July 2012 – June 2013 conductivity sonde deployment information, separated by transect, for the A.R.M. Loxahatchee National Wildlife Refuge. X = data collected from sonde deployment during that month. Graphical representation of station locations are shown in Figure 1. Stations labeled DECOM were decommissioned.

	2012						2013					
Site ID	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
LOXA104	X	X		X	X	X	X	X	X	X	X	
LOXA105		X		X		X		X		X		X
LOXA106		X		X		X		X		X		X
LOXA107		X		X		X		X		X		X
LOXA108		X		X		X		X		X		X
LOXA111	X		X		X		X		X		X	DECOM-->
LOXA112	X		X		X		X		X		X	DECOM-->
LOXA113	X		X		X		X		X		X	DECOM-->
LOXA114	X		X		X		X		X		X	DECOM-->
LOXA115	X	X		X	X	X	X	X	X	X	X	
LOXA116	X		X		X		X	X		X		X
LOXA117	X		X		X		X	X		X		X
LOXA118	X		X		X		X	X		X		X
LOXA119	X		X		X		X	X		X		X
LOXA120	X		X		X		X	X		X		X
LOXA126	X		X		X		X		X		X	DECOM-->
LOXA127	X		X		X		X		X		X	DECOM-->
LOXA128			X		X							DECOM-->
LOXA129	X	X		X	X	X	X	X	X	X	X	
LOXA130		X		X		X		X		X		X
LOXA131		X		X		X		X		X		X
LOXA132	X	X		X	X	X	X	X	X	X	X	
LOXA133		X		X		X		X		X		X
LOXA135	X	X		X	X	X	X	X	X	X	X	
LOXA136		X		X		X		X		X		X
LOXA137		X		X		X		X		X		X
LOXA138		X		X		X		X		X		X
LOXA139		X		X		X		X		X		X
LOXA142	X	X		X	X	X		X	X	X	X	
LOXA143	X	X		X		X				X		X
LOXA144	X	X		X		X		X		X		X
LOXA145	X	X		X		X		X		X		X
LOXA146	X	X		X		X		X		X		X
LOXA147	X	X		X	X	X	X	X	X	X	X	X
LOXA148	X	X		X		X		X		X		X
LOXA149	X	X		X		X		X		X		X
LOXA150	X		X	X		X		X		X		X
LOXA151	X	X		X	X	X	X	X	X	X	X	
LOXA152	X	X		X	X	X	X	X	X	X	X	
LOXA153	X	X		X	X	X	X	X	X	X	X	
I-8C	X	X	X	X	X		X	X		X	X	X
LOX04		X		X		X		X		X		X
LOX06	X		X		X		X		X		X	DECOM-->
LOX07	X		X		X		X		X		X	DECOM-->
LOX08	X		X		X		X		X		X	DECOM-->
LOX09	X		X		X		X		X		X	DECOM-->
LOX10	X		X		X		X		X		X	DECOM-->
LOX15	X	X		X		X		X		X		X

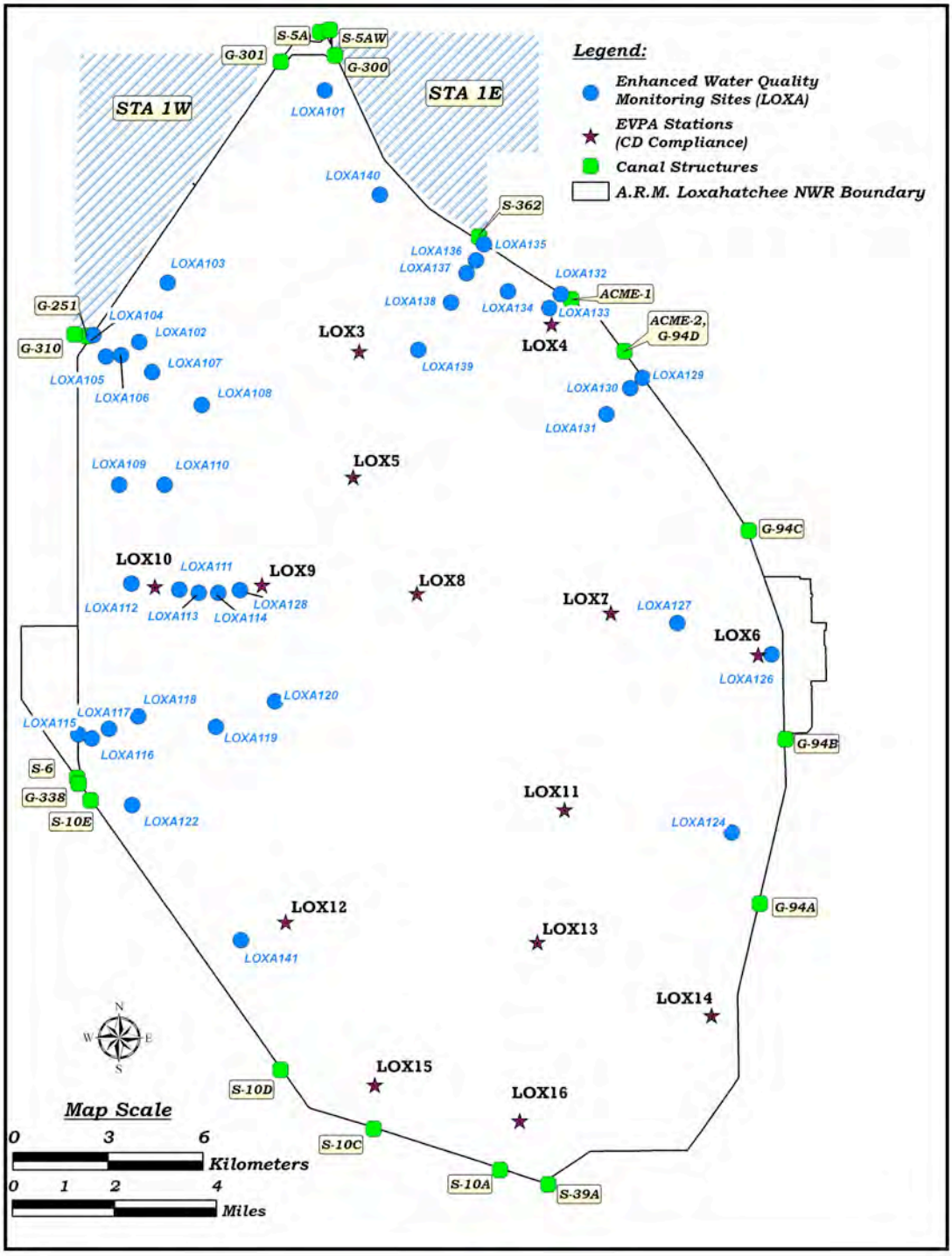

Figure 1. Location of Enhanced Water Quality Monitoring network stations (LOXA###), in relation to Consent Decree compliance stations (LOX##), for the A.R.M. Loxahatchee National Wildlife Refuge.

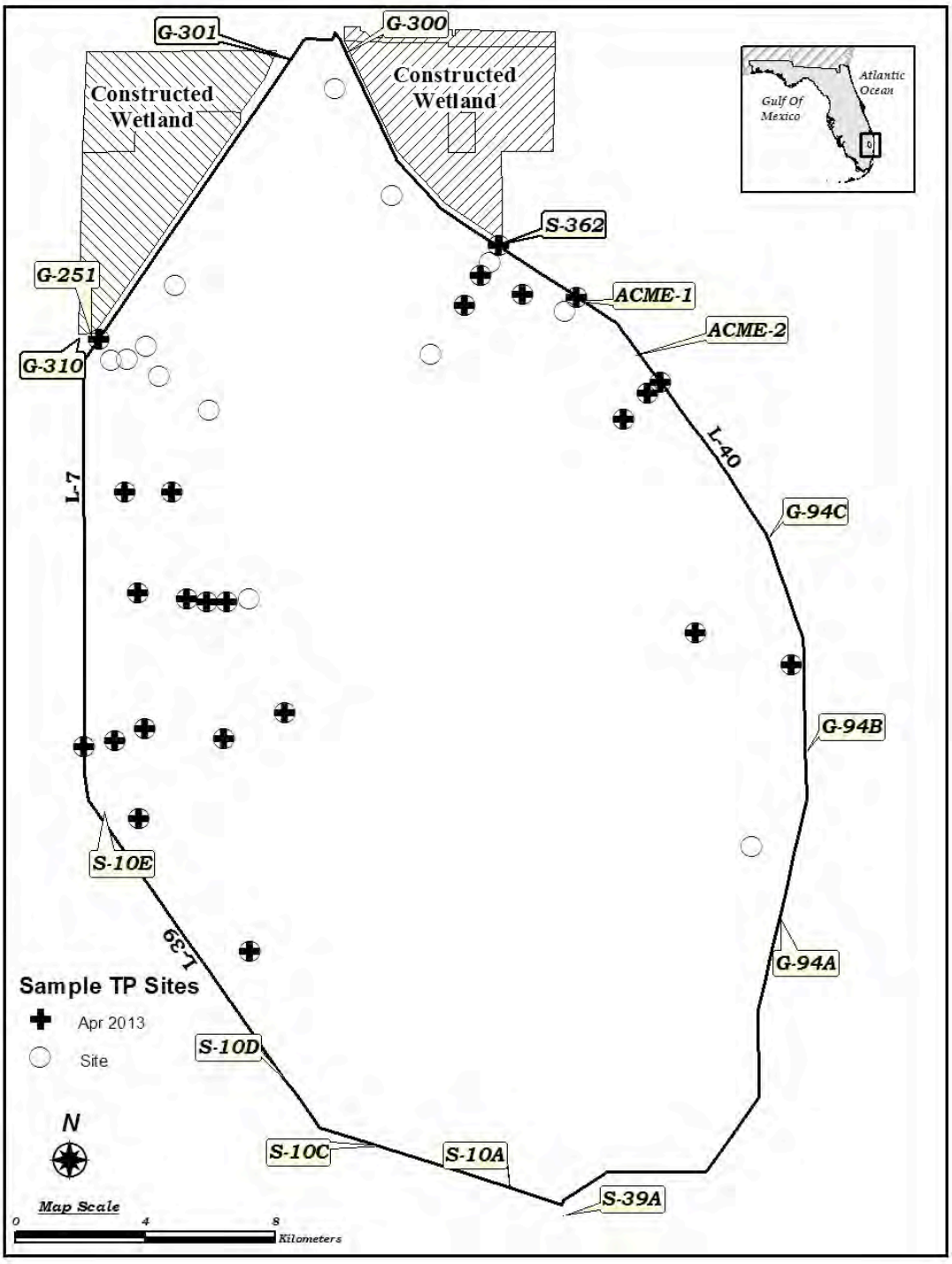

Figure 2. April 2013 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

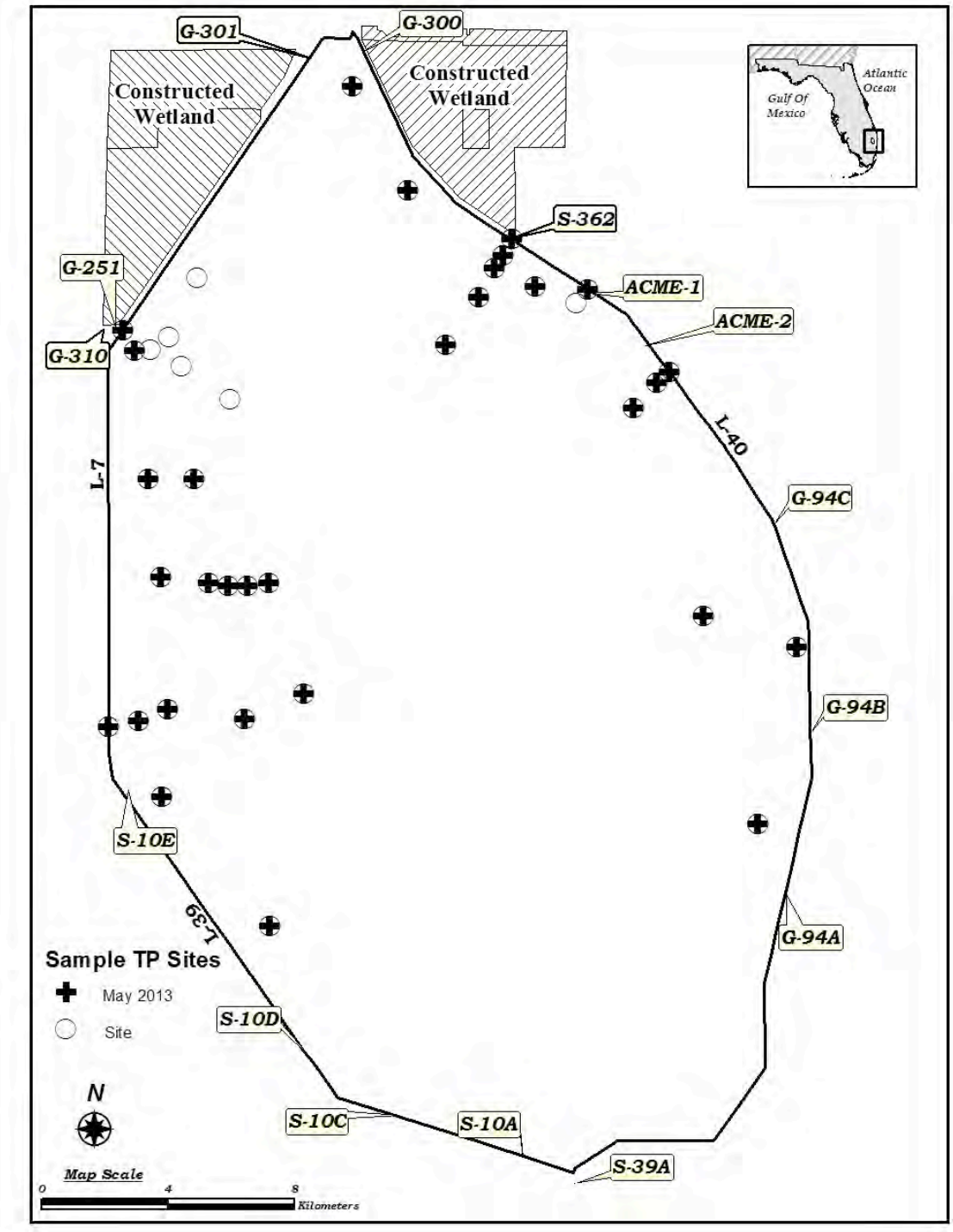

Figure 3. May 2013 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.

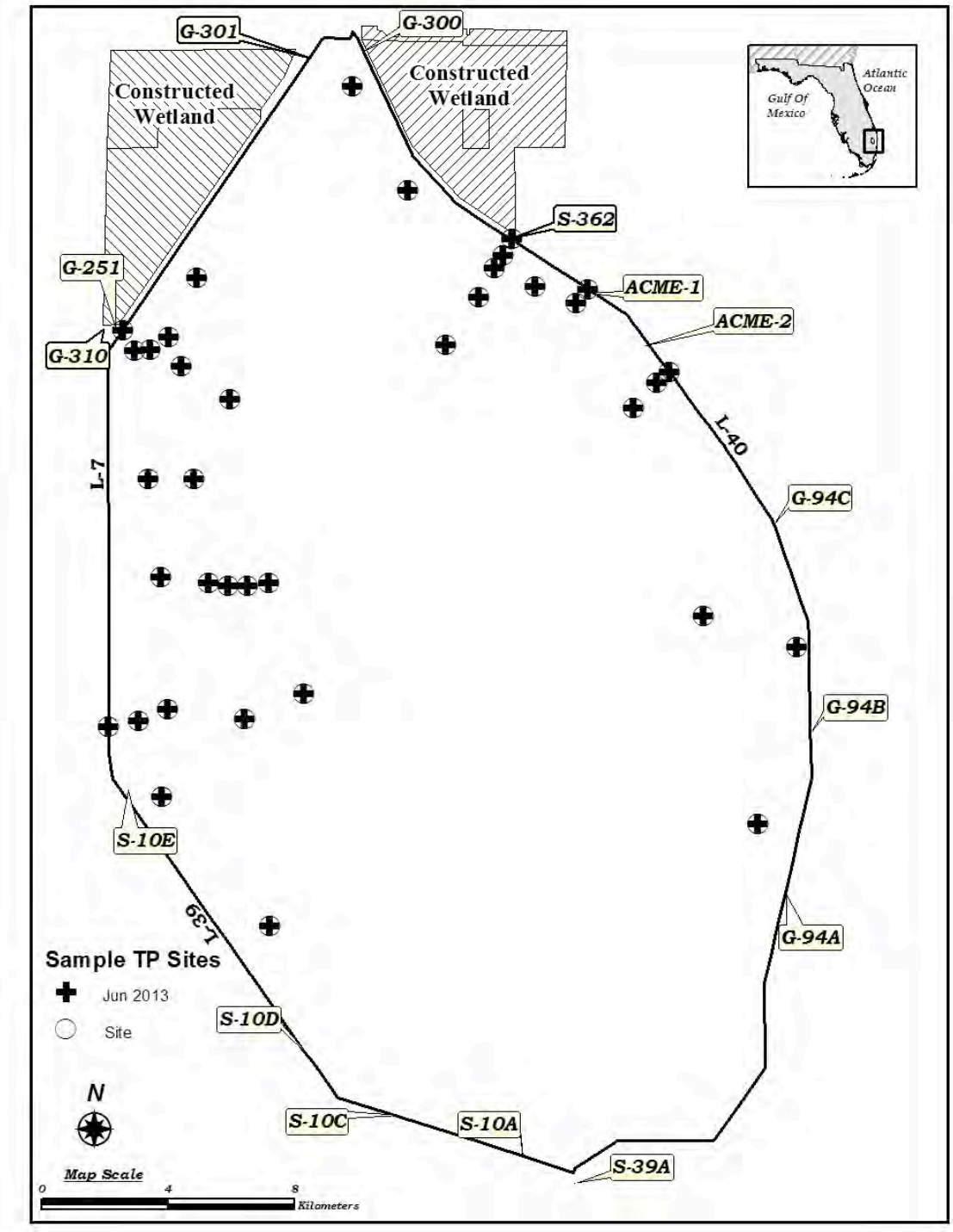

Figure 4. June 2013 map of total phosphorus sample collections from the Enhanced Water Quality Monitoring and the EVPA stations in the A.R.M. Loxahatchee National Wildlife Refuge. A primary reason that a station is not sampled is that it has less than 10 cm of clear water column representative of that area.